# Housing Benefits:
# Baseline Analysis

Glenn H. Ackerman • Alan J. Marcus • Christine Baxter

# Center for Naval Analyses
4401 Ford Avenue • Alexandria, Virginia 22302-1498

Approved for distribution:

Samuel D. Kleinman, Director
Infrastructure and Readiness Team
Support Planning and Management Division

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To improve the quality of life of service members and increase overall efficiency, the Deputy Assistant Secretary of the Navy for Installations and Facilities asked CNA to examine Department of the Navy (DON) housing processes, identify options and alternatives to the current system, and evaluate these options. In this paper, we present our analysis of current DON housing practices. Its purpose is to describe the current state of housing benefits, including costs, conditions, processes, and value to the service members. These descriptions will serve as a baseline for comparison with proposed alternatives to the current housing system. This paper has five parts. In the first, we give a short overview of current DON housing benefits and summarize the results of the study. In the three sections that follow, we discuss current family housing, bachelor housing, and off-base allowances. In the last section, we list our conclusions.

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# Contents

# Introduction

To improve the quality of life of servicemembers and increase overall efficiency, the Deputy Assistant Secretary of the Navy for Installations and Facilities asked CNA to examine Department of the Navy (DoN) housing processes, identify options and alternatives to the current system, and evaluate these options. DoN approved the formal study in April 1996.

In this paper, we present our analysis of current DoN housing practices. Its purpose is to describe the current state of housing benefits, including costs, conditions, processes, and value to servicemembers. These descriptions will serve as a baseline for comparison with proposed alternatives to the current housing system. We have analyzed these alternatives more fully in [1, 2].

This paper has five parts. In the first, we give a short overview of current DoN housing benefits and summarize the results of the study. In the three sections that follow, we discuss current family housing, bachelor housing, and off-base allowances. In the last section, we list our conclusions.

# Overview of current housing benefits

The Department of the Navy (DoN) currently spends about $4.1 billion a year for on-base family housing, on-base bachelor housing, and off-base allowances. The three types of housing benefits are administered separately, leading to great inequalities in what servicemembers receive.

## Benefits to families

Families living on-base receive their rent and utilities for free. Their assigned home depends upon their paygrade and family size–the larger the family, the larger the home. Families living off-base receive a tax-exempt housing allowance consisting of the Basic Allowance for Quarters (BAQ) and the Variable Housing Allowance (VHA). Together, the allowances cover, on average, 80 percent of a family's housing and utilities costs. The housing allowance is independent of family size.

Currently, the U.S. Navy spends about $1 billion a year for on-base housing for one-quarter of its families stationed in the United States. The other three-quarters of Navy families in the United States receive allowances costing about $1.5 billion a year. This means that, at the present time, about 40 percent of the Navy's budgeted resources for family housing benefits are going to just 25 percent of the families.

Whenever there is a dual system with such inequitable benefits, people line up for the side with the greater subsidy. Family housing is no exception; currently, the Navy has waiting lists typically ranging in length from 1 to 5 years. The wait tends to be especially long for larger families, because they receive the biggest benefits from on-base housing.

# Benefits to bachelors

Bachelor housing is an amalgam of permanent party housing and temporary housing. Unlike families, most bachelors live on-base. The Navy houses almost two-thirds of its bachelors in government housing; the Marine Corps houses seven-eighths. Most of these servicemembers are forced to live on-base. Enlisted bachelors below E6 typically are required to live on-base[1] or aboard ships.[2]

As with families, bachelors who are not housed on-base receive a tax-free allowance covering about 80 percent of their housing costs. This allowance is typically between 65 and 70 percent of the amount paid to servicemembers with dependents.

Although some families are eager to live on-base, evidence suggests that most bachelors would much rather live off-base. This is because bachelors do not receive the same benefits as families. Whereas families housed on-base are assigned to separate homes, bachelors are assigned to dormitory rooms, often with several roommates. Also, at any given time, 36,000 bachelors are in homeport and housed aboard ship.

# Costs and perceived value

Table 1 shows the government's cost per servicemember for on- and off-base housing for Navy families and bachelors. The first column shows our estimates of the full cost of Navy housing to the entire federal government. The second column is the average cost per Sailor for allowances, given the paygrade mix of those currently living off-base. The third column contains a hypothetical estimate; it is the average allowance cost per Sailor, assuming allowances were extended to all Navy military personnel stationed in the United States.

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1. At many Navy bases, E5 bachelors now have the option of receiving off-base housing allowances.

2. Recent legislation gave bachelor E6s assigned to ships the option to receive off-base housing allowances. That policy was extended to E5s in January 1997.

Table 1. Comparison of annual housing costs per Sailor (FY 1996 $)

| Type | On-base housing costs | Current off-base allowances | Allowance cost if extended to entire service |
|---|---|---|---|
| Families | $15,100[a] | $8,100[b] | $8,100[b] |
| Bachelors | $ 6,700[c] | $5,400 | $4,800 |

a. Assumes maintaining present quality levels. Cost includes $2,000 Department of Education school impact aid.
b. Includes $200 Department of Education school impact aid.
c. Steady-state cost includes upgrading to new 1+1 quality standard.

There is evidence from surveys and actual behavior that servicemembers value on-base housing at far less than it costs. Families, on average, appear to value most on-base housing at $8,600 to $11,000 per year. We do not know how much bachelors will value the future 1+1 standard units,[3] but evidence suggests that they value the current housing at substantially less than housing allowance levels.

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3. The 1+1 standard is the new DoD-wide standard for bachelor housing. The new standard unit is a modern, semi-private dormitory room with a full bath. For lower paygrades, each unit will be shared by two servicemembers; upper paygrades will have the rooms as singles. All the services are supposed to be moving toward this standard.

# On-base family housing

The U.S. Navy currently provides base housing to about 60,400 families or one-quarter of the Navy families stationed in the United States. The Marine Corps houses 26,500 families which is less than one-third of the Marine families in the United States.

In this section, we discuss the costs and benefits of operating these units of family housing. We begin by discussing the full governmental cost of on-base housing. Next, we discuss the servicemembers' valuation of the current system of on-base housing and the benefits that DoN receives from maintaining base housing. We conclude with a look at the procedures DoN uses to determine the amount of base housing it should provide.

## Cost to government

CNA estimates that in steady-state under the current system, it costs the government at least $15,100 to operate and maintain one unit of Navy family housing for a year. By steady-state, we mean the funding required to maintain the present housing inventory and quality levels in perpetuity. These figures are probably underestimates of the true cost because they do not include the price of land.

Table 2 summarizes the breakdown of the family housing costs. The Naval Facilities Engineering Command (NavFac) reports that it spends on average $10,500 annually per unit for operations and maintenance (O&M).[4] Table 3 shows a more detailed breakdown of the O&M costs. In addition to O&M, there are also construction costs. NavFac reports that it costs on average $130,000 to construct a new

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4. This was the amount spent in FY 1996. In subsequent years, the budgets are to go down to about $9,500 per unit. It remains to be seen whether this will be enough to adequately maintain the units.

unit of family housing. We assumed that a unit of family housing will last 50 years; this implies that in a steady-state, the Navy would have to replace 2 percent of its housing stock every year at an average cost of $2,600 per unit. Finally, the Department of Education pays school impact aid to local communities to offset lost property tax revenue. The Department of Education pays $2,000 per school-aged child living in on-base housing. We assumed that an average Navy family has one child attending primary or secondary school.

Table 2. Steady-state annual cost per unit of Navy on-base housing (FY 1996 $)

| Category | Cost |
|---|---|
| Operations and maintenance | $10,500 |
| Steady-state annual construction costs (50-yr life implies replacing 2% of $130,000 annually) | $ 2,600 |
| Education impact aid (Department of Education budget) | $ 2,000 |
| Total | $15,100 |

Our estimates for steady-state costs are actually less than the current costs reported by NavFac. The government presently spends about $17,300 per unit per year. This increased cost includes additional renovation expenses to compensate for past underfunding. This added cost is required to remedy past neglect, but is not necessarily a steady-state cost.

Although we believe our assumptions are conservative, our cost estimates tend to be somewhat higher than those in other military housing studies. The Congressional Budget Office (CBO) studied the subject in 1993 and concluded that military housing costs approximately $13,000 per unit per year [3].[5] The General Accounting Office (GAO) recently concluded a study that estimated the annual

Table 3. Breakdown of annual operations and maintenance costs[a]
        (FY 1996 $)

| Category | Percentage | Cost |
|---|---|---|
| Management service | 10% | $ 1,050 |
| Services (police, fire, pest control) | 7% | $ 735 |
| Furnishings | 4% | $ 420 |
| Utilities | 22% | $ 2,310 |
| Dwelling maintenance and repair (recurring and special) | 47% | $ 4,935 |
| External utilities | 4% | $ 420 |
| Other real property maintenance (ground care, common areas) | 4% | $ 420 |
| Alteration and additions | 2% | $ 210 |
| Total | 100% | $10,500 |

a. Source: NavFac.

cost to the government to be $12,373 per unit of family housing [4].[6]
Although their numeric estimates vary, the CBO and GAO report
overall conclusions similar to ours.

Locally reported O&M costs for family housing have differed from
the $10,500 national estimate. In San Diego, COMNAVBASE
reported costs indicating total O&M to be about $9,000 per unit.
NavFac estimates concurred, reporting an average O&M cost in San

5.  The CBO estimates differed from ours mostly in operations and main-
    tenance. CBO estimates O&M costs to be just $6,200 per unit per year.
    However, they partially offset this difference by including amortized
    costs of capital and land, omitted here because it requires amortizing
    sunk costs that may not be fully recoverable. Our estimate is designed to
    be a steady-state funding requirement, assuming the status quo capital
    stock, rather than a full theoretical opportunity cost involving the sale
    of existing government assets. CBO's estimate of education impact aid
    agrees well with ours.

6.  GAO estimates O&M to be $8,092 annually per unit. Their estimate for
    capital investment and land is $2,803, slightly more than our steady-state
    annual construction cost. Their estimate of school impact aid per on-
    base family is about $500 a year less than ours.

Diego of $8,800 per unit. However, family housing personnel in Norfolk reported average O&M costs to be about $6,500 per unit per year. NavFac and CincLantFlt reported O&M costs to be $14,700 per unit per year in the Norfolk area. We have not been able to completely reconcile these figures.

## Marine Corps costs

The Marine Corps also reports significantly lower O&M costs. It reports an average annual cost of $8,600 per unit, which would mean its total family housing costs would be $13,200 per unit. The Marine Corps states that it runs a leaner, more efficient operation, and that the Defense Business Operating Fund (DBOF) artificially inflates Navy costs. We were not able to either verify or refute these statements.

# Benefits of on-base family housing to servicemembers

Equally important as the cost of on-base housing is its value to servicemembers and DoN. For example, if it costs $15,000 a year to own and operate a unit of on-base housing and that unit is worth $20,000 to a Sailor or Marine, then on-base housing is probably a worthwhile benefit for the government to provide. However, if Sailors and Marines value that unit at substantially less than its $15,000 cost, then those benefits probably can be better allocated. In this section, we try to estimate boundaries for servicemembers' valuation of the system of base housing.

## Background to estimation analysis

Because there is no open market for military family housing, it is difficult to determine its precise value to servicemembers. Under the current system, Sailors or Marines assigned to a base may put their families on waiting lists for on-base housing. These waiting lists may vary in length from a few months to a few years. There is no guarantee that individual servicemembers will ever be able to move their families into base housing during their military careers. Some, however, probably spend much of their careers there. Since on-base units

essentially are rationed on a first-come first-served basis, there are no explicit prices that can be used to assess value.

In one sense, on-base family housing is like giving a lottery ticket to servicemembers. Its value will depend upon the quality of the housing, the preferences of that servicemember, and the probability of actually getting on-base. We can evaluate the system of base housing according to these three criteria: quality, preferences, and probability. Although it is difficult to come up with a single, final dollar value for on-base housing, all indications are that the average servicemember values on-base housing at far less than the $15,100 it costs the government.

## Estimating the quality of specific housing units

The quality of current on-base family housing varies tremendously. Much of the current stock is in poor condition. The Marsh panel called nearly two-thirds of military housing unsuitable [5], although that is probably a significant overstatement. However, some housing is in very good condition. Revitalized Capehart homes in San Diego and the newly built Ben Moreell homes in Norfolk, for example, would probably be desired by most families.

### Independent appraisals

NavFac commissioned independent appraisals of three types of Navy family housing in the San Diego area. The results are listed in table 4. The most expensive unit is a revitalized four-bedroom detached home in the Chesterton complex. Without doubt, it is a lovely home, about as nice as Navy housing gets. However, even this best of Navy homes only had an appraised rental value of about $15,000 a year including utilities. If the best units are only worth $15,000 a year, the majority of the units nationwide must be worth substantially less.

### Revealed preferences

To estimate the value of additional housing units in San Diego, we employed a revealed preferences technique. Revealed preferences involves looking at people's actual behavior to determine value. San Diego is unique among naval housing areas in that each complex has its own waiting list. The waiting lists vary in length for each complex,

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Table 4. Direct appraisals of San Diego housing units[a] (FY 1996 $)

| Complex | Type of unit | Estimated annual rent including utilities |
|---|---|---|
| Chesterton (Capehart homes) | Revitalized 4 bedroom | $15,000 |
| Murphy Canyon | 3 bedroom | $13,000 |
| Howard Gilmore | 2 bedroom | $10,500 |

a. Source: NavFac.

and servicemembers may choose just one. Sailors who live on-base forego their BAQ and VHA payments. In a sense, this is like an implicit rent payment, and the higher a sailor's paygrade, the higher the allowance level, and the higher the implicit rent.

We examined occupancy data by paygrade and number of bedrooms for three of the largest military housing complexes in San Diego: Murphy Canyon, Cabrillo Heights, and Gateway Village. Together, they make up about 45 percent of the military housing available in the area. In addition, all three complexes are open to enlisted personnel of all paygrades.

The data revealed several patterns. For example, there are some units and complexes that servicemembers beyond a specific paygrade do not live in, even though they are eligible. This means that there is a level of implicit rents for the units beyond which all Sailors prefer their BAQ and VHA.

For example, in Murphy Canyon, E8s live in two-bedroom units, but not E9s. This indicates that some E8s prefer those two-bedroom units to their $11,100 annual allowance level; however, no E9s prefer those to their higher allowance level of $11,500. This indicates that these units must have an implicit rent between $11,100 and $11,500. This agrees well with the appraised value of $13,000 for a three-bedroom unit in Murphy Canyon; it is quite possible that an additional bedroom could be worth $1,500 to $1,900 a year more than the two-bedroom unit.

In Cabrillo Heights, E7s live in the two-, three-, and four-bedroom units, but no E8s live in the complex. This indicates that some E7s regard the units as worth more than their $10,500 housing allowance, but nobody regards the units as worth more than the E8's $11,100 allowance. Again, this creates a range for the implicit rent.

Table 5 lists the complete results of the revealed preference analysis. Most of the units appear to be valued in the $10,000 to $11,000 range.

Table 5. Revealed preferences for San Diego housing complexes (FY 1996 $)

| Unit size | Complex | Residents | Minimum value | Maximum value |
|---|---|---|---|---|
| 2 bedroom | Murphy Canyon | E8s, but not E9s | $11,100 | $11,500 |
| 2,3,4 bedrooms | Cabrillo Heights | E7s, but no E8s | $10,500 | $11,100 |
| 1 bedroom | Gateway Village | E6s, but no E7s | $ 9,400 | $10,500 |
| 2,3,4 bedrooms | Gateway Village | E7s, but no E8s | $10,500 | $11,100 |

## Survey preferences

Since on-base housing is not transferable, it is not enough simply to determine its market value. Sailors and Marines cannot sublet their space in base housing and go live in town, nor can those in-town decide to move on-base by subletting from a current resident. Continuing with the lottery analogy, if the prize of a lottery is a $10,000 diamond bracelet that the winner can never sell, its value will depend upon the winner's personal preferences. The same is true of on-base housing. We need to examine individual preferences toward actually living on-base to determine its value.

There is strong evidence that preferences for base housing vary from person to person. For example, only 16 percent of Navy families in the private sector are on a waiting list. To many of these 16 percent, base housing is more valuable than BAQ and VHA even if they have

to wait for it. For the 84 percent who are not on a waiting list, some are deterred by long lead times and might prefer base housing over allowances if they did not have to wait. However, some of that 84 percent probably do not want to live on-base at all; for them, base housing is worth less than their current housing allowance.

The 1995 VHA survey asked the question: "If military housing had been available when you reported to this duty station, would you have elected to live in government housing instead of private sector housing?" We used the answers to this question to help estimate overall Sailor and Marine preferences.

We assumed that everyone who is now living in base housing would have answered "yes" to this question.[7] We then adjusted the survey responses accordingly to come up with the graph of housing preferences for Sailors by paygrade, shown in figure 1.

Figure 1.   Family housing preferences by paygrade



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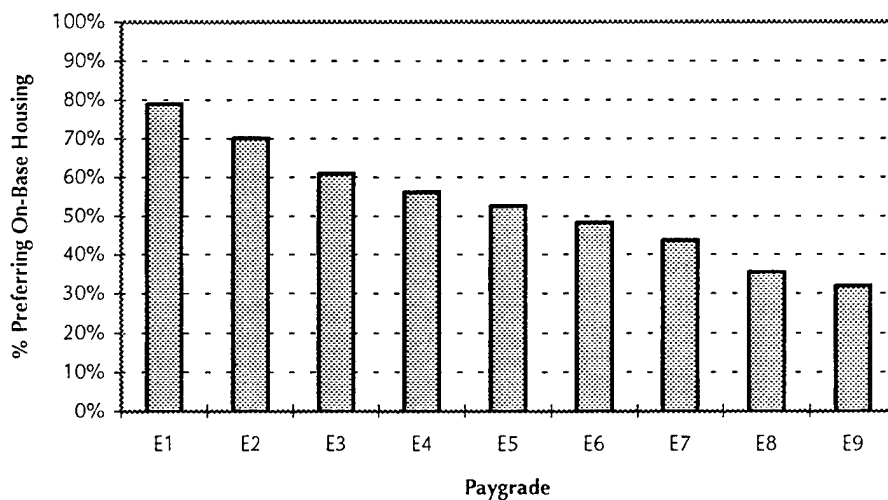
7. We used the average of the CNA estimate range in figure 8 to calculate the number of families living on-base by paygrade.

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As paygrade increases, the preference for on-base housing diminishes. There are two reasons for this: Higher paygrades receive larger housing allowances, and their higher base pay makes it easier to afford out-of-pocket expenses. An increase in allowances can be thought of as the increased opportunity cost or the "implicit rent" for accepting on-base housing.

Beginning at the E6 paygrade, more sailors prefer their allowances to base housing. The average E6 Sailor receives $8,600 annually in housing allowances; most value that money more than base housing. They value their home off-base more than a home on-base, even though they will have to pay $2,050 annually out-of-pocket.

Higher allowances would also induce lower paygrades to prefer off-base housing. $8,600 may not be sufficient for all paygrades, because junior personnel may not be able afford the out-of-pocket expenses. However, it is probably safe to assume that if offered a $10,650 housing allowance (an E6 home with no out-of-pocket expenses), most Sailors in all paygrades would prefer to live off-base. This provides an estimate of the upper value of on-base housing for most Sailors.

Offering $10,650 in allowances probably would not be sufficient to induce all people to prefer off-base housing. In figure 1, there is a core minority of about one-third of Sailors who prefer on-base housing even at the E9 allowance level and pay level.[8]

By running regressions and using additional data, we were able to further characterize those demographic groups who prefer on- or off-base housing. Detailed descriptions of the regressions and their results are contained in the appendix of this document.

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8. A Navy E9 receives an average housing allowance of $10,000 per year, $650 less than the price of an E6 home. Although one cannot tell for sure, the trend of the graph in figure 1 indicates that even with an additional $650 in allowances per year, a sizable minority of E9s would still prefer base housing.

**Family size**

Analysis of the 1995 VHA survey responses regarding preferences for base housing showed that the larger a Sailor's family, the more likely he or she was to prefer base housing. This is not surprising because larger families housed on-base receive larger units, whereas the allowance they would receive for private sector housing remains the same regardless of family size. This means that larger families receive a greater subsidy on-base than smaller families. Figure 2 shows the preferences for base housing as reported in the VHA survey for families with no children, one child, and two children.[9] The effect of family size is clearly evident in paygrades E1 to E7.

Figure 2.   Preferences of Navy personnel living off-base by family size[a]
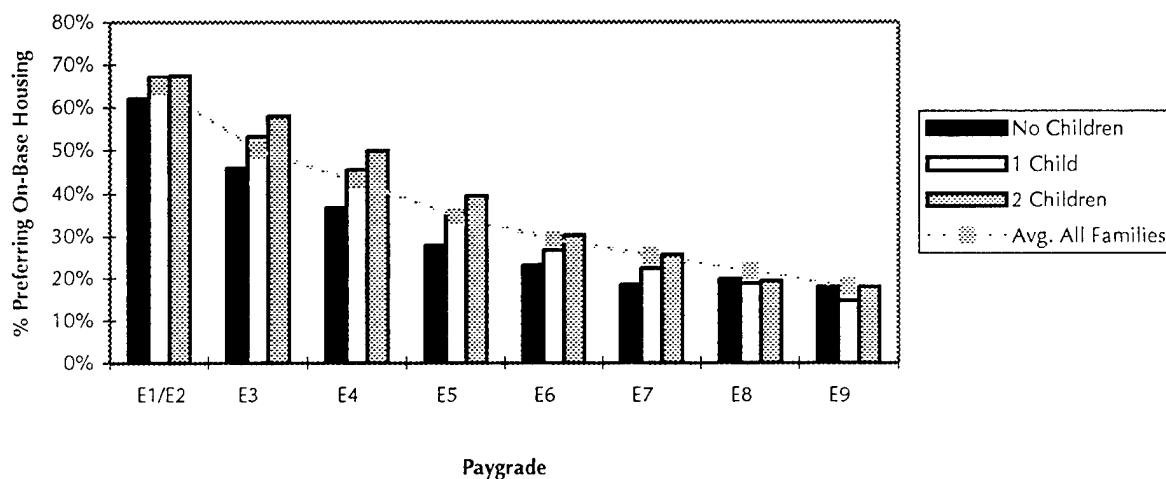


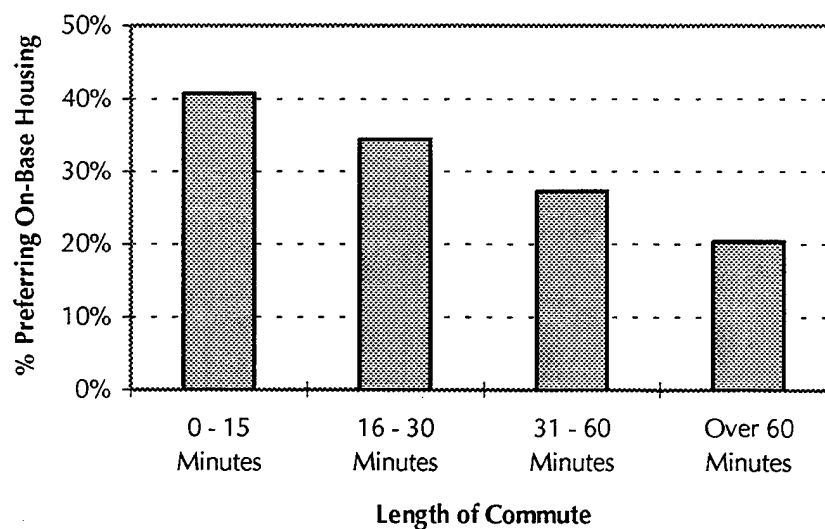a. Source: 1995 VHA Survey.

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9.   Note: We could not adjust the data for those currently living on-base as in figure 1 because we could not get such detailed data for on-base residents.

Note that figure 2 contains raw data responses. When we ran regressions to isolate the preference effects of family size we found that having children raised the preference for base housing by 3 to 5 percentage points per child.

**Commuting distance**

Long commuting distances made people less likely to prefer on-base housing. The longer the commute time, the stronger the preference for private sector housing; these people apparently want to separate their homelife from their workplace. Figure 3 shows this effect in aggregate for all enlisted paygrades. In addition, the detailed raw data showed precisely the same pattern for each enlisted paygrade, E1 to E9.

Figure 3. Housing preference by commuting time for Navy enlisteds[a]

The regression analysis to isolate the commuting time effect showed that those with over an hour commuting time were from 9 to 15 per-

centage points less likely to want base housing than those with very short commutes. Those with a half hour to an hour commute were 6 to 9 percentage points less likely to want base housing. Those with moderate commutes of 16 to 30 minutes were 3 to 4 percentage points less likely to want base housing.

## Military spouse

The 1995 VHA survey also asked whether one's spouse was also in the military. Figure 4 shows that those with military spouses were considerably less likely to desire military housing. This effect could be seen in all enlisted paygrades.

This result is also expected. Military couples both receive housing allowances, but at the single rate. Together, these two single-rate allowances (assuming both husband and wife are in the same paygrade) equal about 30 to 40 percent more than the corresponding allowance level for those with civilian spouses. In other words, military couples receive a greater-than-average allowance if they choose private sector housing, but they receive only an average home if they choose base housing. As with the previous results, the higher the allowance, the less likely the servicemember is to want base housing. In addition, military couples, by definition, have two full-time working incomes which makes private sector housing more affordable.

## Working spouse

Although the VHA survey does not ask whether one's spouse works, we have other data that show a correlation between working spouses and private sector housing. The 1992 Department of Defense Surveys of Officers and Enlisted Personnel show that families living off-base are more likely to have spouses who work full-time than are those who live on-base. Families living on- and off-base have about the same percentage of spouses who work part-time. Families on-base are significantly more likely to have spouses who are not employed. Figures 5 and 6 show these results after correcting the survey data for male and female ratios.[10] Figure 5 shows the result for paygrades E1 to E4; figure 6 shows the result for paygrades E5 to E9.

Figure 4.  Preference of Navy personnel off-base by military / civilian spouse[a]
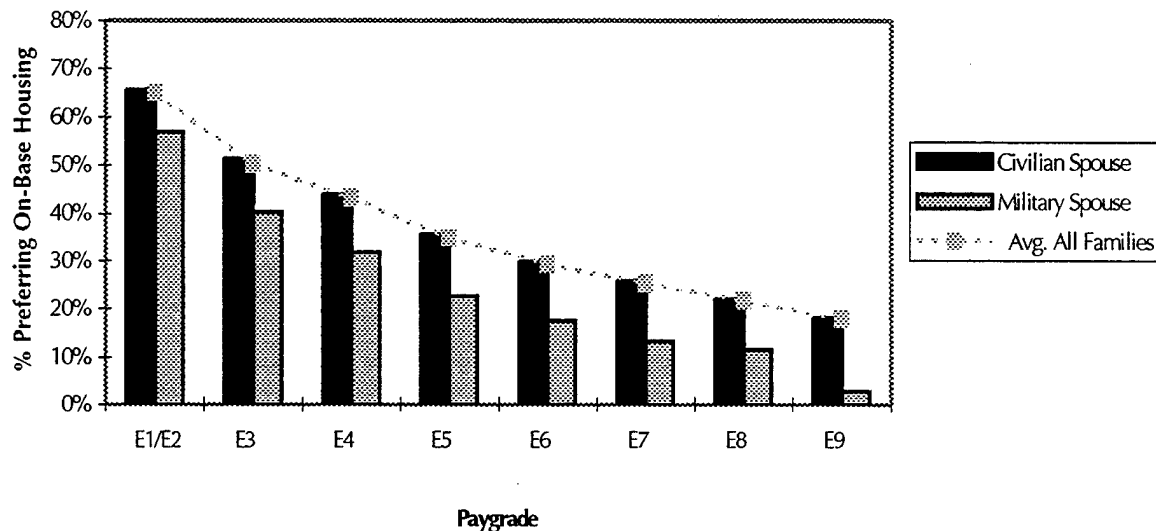
Note that figures 5 and 6 only show correlations between work status and living area. This may be because dual-income families have more money and prefer to live in better housing than is offered on-base, or it may be that families in the private sector find themselves short of money, thus forcing the spouse to work. Although these data do not distinguish the two hypotheses, the previous result that families with military spouses prefer private sector housing suggests that the first hypothesis is probably more correct.

10. The 1992 DoD Surveys of Officers and Enlisted Personnel oversampled female and minority servicemembers. The graph data were adjusted to reflect the correct Navy male-to-female ratio. Minority status did not seem to matter when it came to spousal employment so no additional adjustment was made.

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Figure 5. Spousal employment for Navy E1 to E4s on- and off-base (1992)[a]



**Spousal Employment Status**
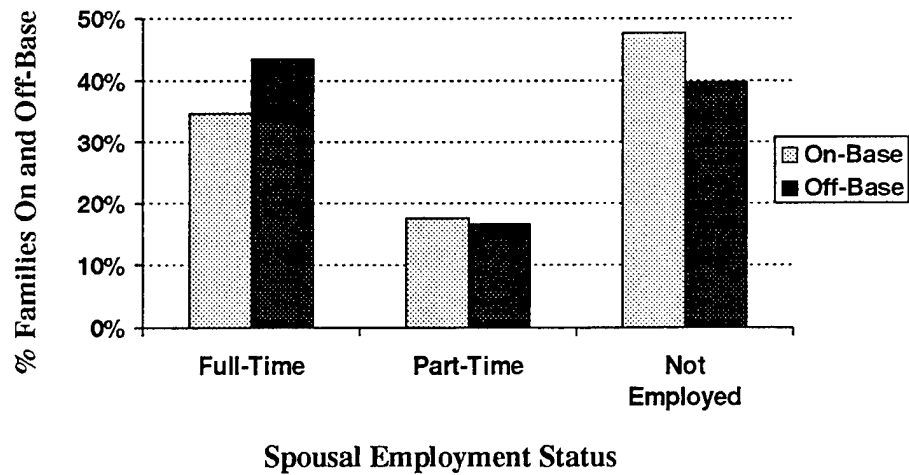
a. Source: 1992 DoD Surveys of Officers and Enlisted Personnel.

Figure 6. Spousal employment for Navy E5 to E9s on- and off-base (1992)[a]



**Spousal Employment Status**
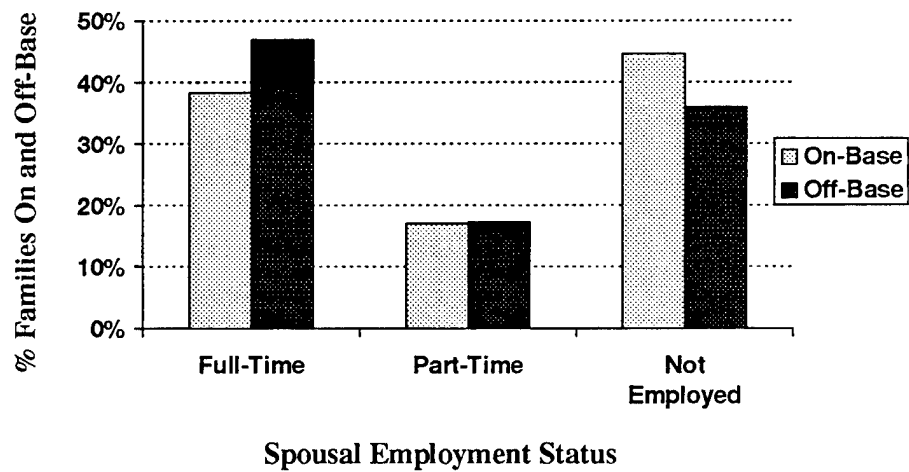
a. Source: 1992 DoD Surveys of Officers and Enlisted Personnel.

**Marines versus Navy**

The 1995 VHA survey also allows us to distinguish between Marine and Navy responses. Figure 7 shows this comparison for preferences for base housing. Although the raw data in the graph appear ambiguous with E1 to E4 Marines showing less preference than Sailors for base housing and E5 to E9 Marines showing a greater preference, our regression analysis showed that Marines have a slightly stronger preference for base housing. The regressions controlled for other demographic variables, thereby isolating the service effect. It showed that Marines have from 2 to 3 percentage points greater preference for base housing than Sailors.

Figure 7. Preferences of off-base enlisted families by service[a]
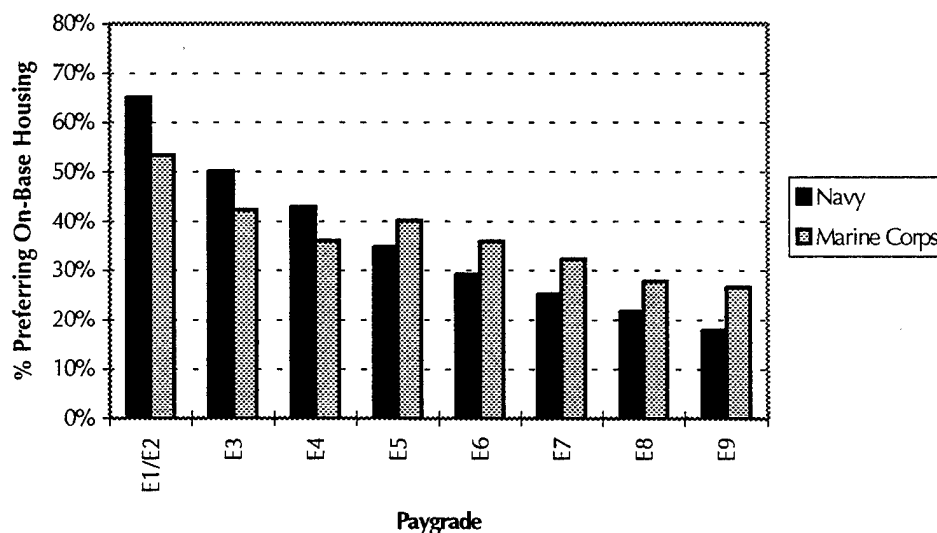
## Probability of living on-base

We have just discussed the value of base housing, assuming service-members, themselves, could decide whether or not to live there. The remaining key factor is the likelihood that servicemembers who want base housing will actually get to live there. The greater this probability, the more valuable the system of base housing becomes. If there were no waiting lists, the value of base housing would approach a servicemember's preference level.

At any given time, about one-quarter of Navy families and one-third of Marine families live in government housing. This probability may not be evenly distributed. In the following sections, we discuss which Sailors are the most likely to actually live on-base.

### Distribution of base housing by paygrade

The probability of actually living on-base varies throughout an enlisted's career. CNA estimates for Navy data show that midgrade Sailors (E5 to E7) have the greatest probability of living on-base. Figure 8 illustrates the estimated percentage of enlisteds living on-base.

Because it was hard to determine exactly which paygrades were occupying base housing, we estimated a percentage range for each paygrade living on-base. The lower bound of the percentage range was designed to be a clear underestimate of the true value. The lower bound estimate was calculated as the number of families stationed in the United States (from Enlisted Master Record data) less the number of families receiving full BAQ worldwide (from DoN FY 1997 budget estimates), and then converted to a percentage value. The upper bound value is the percentage of Navy families worldwide living on-base; because DoN houses a greater proportion of those stationed abroad, this should be a clear overstatement of the true U.S. values. Due to inconsistencies in the two data sources, we could not estimate the E1, E2, and E3 Sailors separately; the values shown for these paygrades in figure 8 were a group estimate.

Although we are fairly confident that the true percentages fall within our estimated ranges, there are other estimates for those living on-

Figure 8.   Enlisted paygrades living in on-base Navy housing
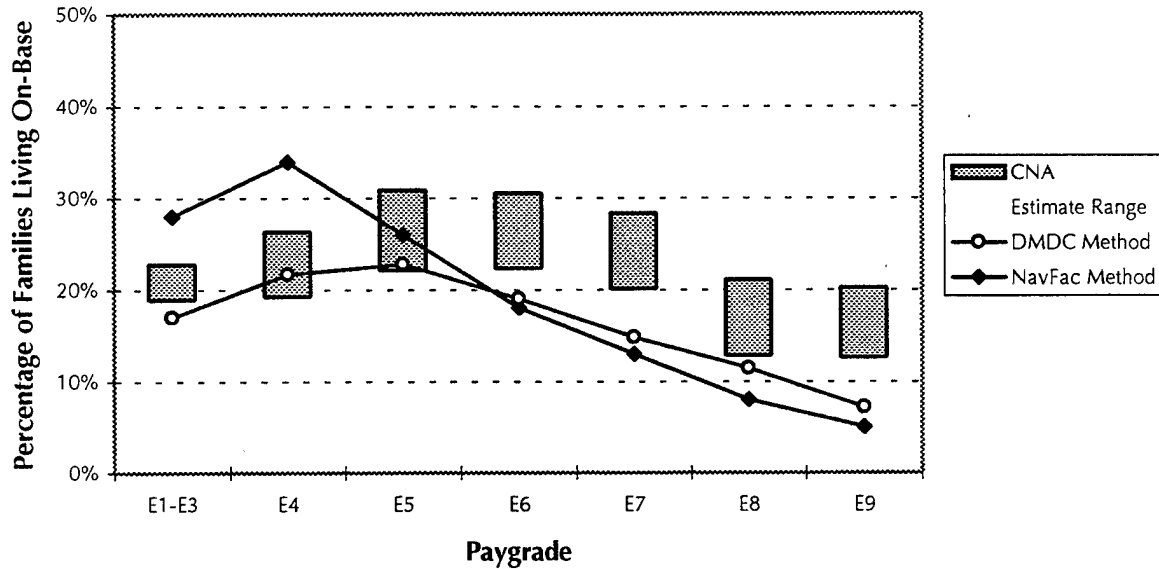


base. For example, NavFac used a sample basket of 12 bases to esti-
mate percentages of those living on- and off-base. The Defense Man-
power Data Center (DMDC) used payroll data to estimate those
receiving allowances. These estimates are also included in figure 8.
These two other methods produce very different estimates which
often are not within the CNA ranges. NavFac estimates a far greater
percentage of E1 to E4 families living on-base. DMDC estimates far
fewer E1 and E2 families living on-base. For E6s and above, the other
estimates are below the lower bound of the CNA estimate range.

**Overall distribution of housing benefits**

Even knowing which paygrades live on-base does not tell us just how
widely the family housing benefit is distributed. During the course of
a military career, do all families get an opportunity to live on-base or
is that benefit limited to a few lucky families who live there for many
years at a time?

Ideally, we would like to know the distribution of those moving out of military housing—how long did they actually stay? These data are not available. However, NavFac has gathered data to form a snapshot of the occupancy tenure of families currently living in government housing at the 12 designated homebasing sites. If we assume that this "snapshot" distribution is representative and will be stable over time, we can estimate a tenure distribution of those vacating Navy housing. The calculation shows the distribution of housing to be fairly equitable. About 85 percent of those vacating space in on-base housing would have been there less than 5 years. About 15 percent would have been there for 5 years or longer.

Nevertheless, with waiting lists of one year or more, the system is biased against those Sailors who move around a lot. They would not stay at any base long enough to enjoy base housing for any significant period of time. These Sailors may also be the most vulnerable. They have to find housing for their families in new cities where they may have limited information. If their spouses work, the families may lose considerable income while new jobs are lined up. It is ironic that the Sailors who are drawn to the classic Navy recruiting appeal "to see the world" will be the ones who are penalized the most in terms of housing.

# Benefits of on-base family housing to the Navy and Marine Corps

Apart from the direct benefits to servicemembers, keeping families on-base may provide overall benefits to the Navy and Marine Corps. Having junior personnel on-base may allow the services to act "in loco parentis" and keep a watchful eye on them. It may also help these junior personnel assimilate into military life.

Some have argued that having families on-base has an impact on readiness. It reassures Sailors and Marines who are being deployed that the service will look after their families. This added peace of mind may help servicemembers be better Sailors and Marines.

These two arguments are often cited to support on-base housing. We have no evidence to support or refute either of them, except to say

that the current system does not maximize either goal. Most family housing resources now go to the middle and upper paygrades, not to junior enlisteds. Figure 9 shows the distribution of Navy family housing resources among the paygrades.[11] Only about one-quarter of family housing is occupied by E4s or below. Also, Sailors and Marines in deployable billets get no special priority for on-base housing. Clearly, much of current on-base housing does not achieve either benefit for the military.

Figure 9.   Distribution of Navy enlisted family housing assets by paygrade
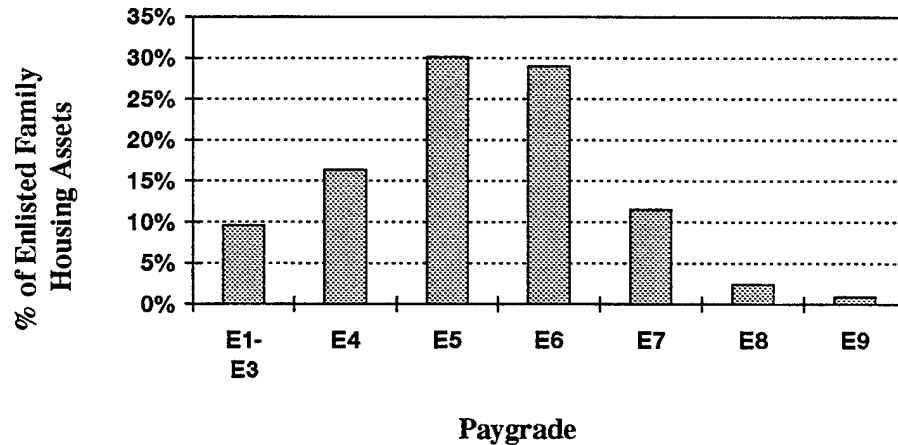


## Requirements

Current DoD family housing policy is to rely on the private sector wherever possible; base housing would be used when it is necessary to ensure readiness or when adequate and affordable private housing is not available [6]. Until passage of the recent 1996 authorizations, DoN had few options for improving family housing benefits. Typically, no cost benefit analyses would be conducted to compare various

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11. To calculate figure 9, we used the average CNA estimates of those paygrades living in on-base housing from figure 8.

overall methods[12] of improving housing benefits. Instead, DoN would try to establish that the private sector could not produce enough adequate and affordable housing; DoN then would propose building to alleviate the projected "shortfall."

Arguments that the private sector cannot produce sufficient housing center on two criteria: estimates of a current "deficit" of adequate private sector housing and the projection of future market conditions. The methods for calculating both the deficit and the market projection are seriously flawed. Both are discussed below.

## Deficits

Each year, DoD conducts a Variable Housing Allowance (VHA) survey among servicemembers living in the private sector. The survey asks detailed questions about servicemembers' homes and costs. DoD then has specific criteria to determine whether servicemembers are adequately housed. If they are not, they become part of what is termed the "housing deficit." The current housing deficit for the Navy is about 12,000 units in the United States. For the Marine Corps, it is about 11,000 units.

The problem with the deficit estimates is that the criteria are wrong. If servicemembers pay more than 50 percent of their BAQ amount out-of-pocket, they are determined to be living in unaffordable housing and become part of the deficit. In the Navy, about 69 percent of families in the deficit are there due to this unaffordability criterion. About 32 percent of the families in the total Navy deficit are paying less than $100 a month over the limit. Almost half the deficit (49 percent) are paying less than $200 a month too much.

The major shortcoming with the cost criterion is that the VHA survey never asks whether the servicemember's spouse is working. Housing allowances should permit servicemembers to afford adequate housing. On the other hand, if a servicemember's spouse works and wants to spend an extra $2,000 or so to live in a higher quality home, DoN should not declare they are living beyond their means and use that to

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12. Such as increase allowances versus maintaining base housing.

justify more base housing. The 1992 DoD Surveys of Officers and Enlisted Personnel indicated that most Navy spouses work at least part time. Most likely, the servicemembers who spend the most for housing have working spouses because the private market prevents people from choosing unaffordable homes; landlords typically check credit and employment histories to ensure that tenants can meet their obligations.

Another major criterion for the deficit is commuting distance. DoD claims that servicemembers with more than a one-hour commute are inadequately housed. However, as mentioned earlier, our analysis of the VHA survey shows that, other factors being equal, those with longer commutes are less likely to want on-base housing. In fact, the higher the paygrade, the greater the chance the servicemember will have a commute of 30 minutes or more. Figure 10 shows this result.

Figure 10. Commutes of more than 30 minutes by paygrade[a]
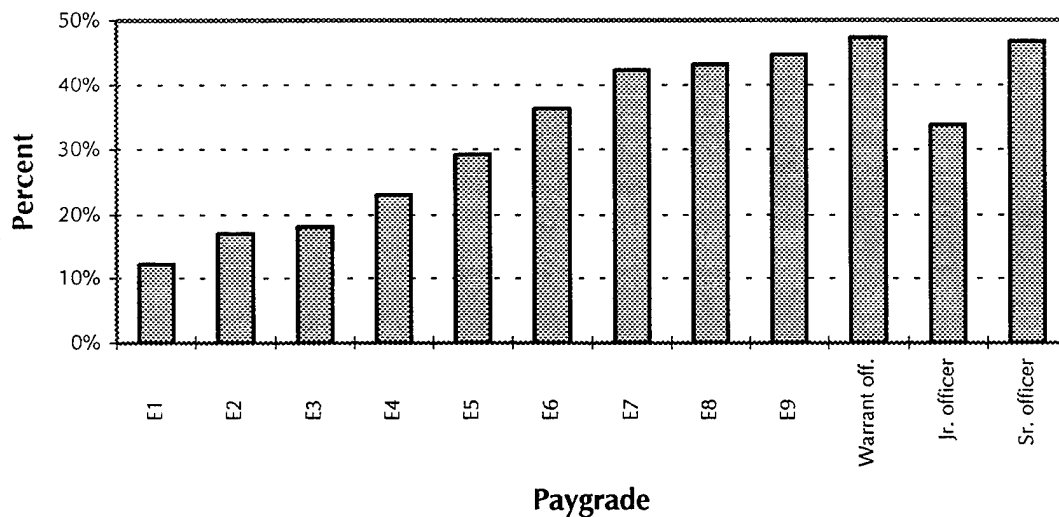
If the Navy builds to reduce the housing deficit, there is no guarantee that those in the deficit will move on-base. Our analysis indicates that many of these people are likely to remain where they are. The result would be building more base housing with little or no reduction in the deficit.

## Market projections

Periodically, DoN hires a consulting firm to project future market conditions in military housing areas. CNA reviewed two of these market analyses, a 1993 study of the Norfolk, Virginia, area [7] and a 1994 study of the San Diego, California, area [8].

The studies use a methodology that is seriously flawed and designed to project an unaffordable private housing stock. The first steps are to estimate the projected supply of rental housing and the projected demand by military families. The next step is to calculate the military's share of the projected supply of rental housing.

The single largest flaw in this method occurs when estimating the rental cost for the military's share of the housing. Instead of assuming that military personnel will rent from the stock of housing they can afford, the methodology assumes that the rental prices of the military's share of housing will be distributed as it is for the entire community, as documented by the U.S. Census. In other words, if the Census records that 25 percent of the one- and two-bedroom units in the community rent for $1,000 to $1,500 a month, then the market analysis assumes that 25 percent of the units in the military's share of housing must also rent for $1,000 to $1,500 a month.

The weakness of the methodology becomes clear when applied to items other than housing. As an example, we will consider transportation. Assume that the military makes up 20 percent of a community. Therefore, 20 percent of the automobiles sold in the area will be to military personnel. Suppose that 10 percent of the cars sold in the community last year were Lexuses. This method assumes that 10 percent of the cars sold to military personnel must also be Lexuses. However, most military personnel cannot afford Lexuses. Therefore, the private sector will not provide adequate transport vehicles to the military. One can reach similar conclusions for most any item.

This methodology ensures that there will always be a housing deficit except in the rare instance when the military income distribution exactly matches, or is higher than, the community's income distribution. Since the military is weighted toward younger people, this would be a rare occurrence.

# Bachelor housing

Unlike families, most military bachelors live in government housing. Worldwide, about two-thirds of Navy bachelors and seven-eighths of Marine bachelors live on-base. In this section, we will examine the costs and benefits of bachelor housing.

## Cost to government

The costs of bachelor housing are far harder to estimate than the costs of family housing. One reason is that bachelor housing is used for both permanent parties and transients, and it is difficult to separate the two. Another is that funding comes from several unfenced accounts, making it hard to determine true expenditures. In FY 1996, DoN reports spending $500 million on bachelor housing; however, we do not know how much went to permanent residents.

DoD is in the process of upgrading its barracks to the new 1+1 standard. Currently, the Navy has relatively few of these rooms. However, we do have data on what it costs to construct, renovate, and operate these units. In Norfolk, it costs $70,000 per room to renovate an old barracks to the new standards, while it costs $120,000 per room for new construction. NavFac reports that the new standard units will cost on average $53,500 per person to construct and $3,200 per person annually to operate. Table 6 summarizes these costs and shows that the annualized opportunity cost of building and operating the new 1+1 standard units will be $6,700 per person.[13]

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13. We derived this figure from a cost calculation that differs from the one used for family housing. There, we were discussing the cost to maintain a steady-state status quo. Here, we are discussing a large upfront investment to alter the status quo; since this money has not yet been spent, it must be amortized over the long-run steady state.

Table 6. Annualized cost to build and maintain new bachelor standards

| Category | Per person cost |
|---|---|
| Annualized opportunity cost of construction ($53,500 per person * 6.5% annual interest rate[a]) | $3,500 |
| Annual operating and maintenance cost | $3,200 |
| Total annual cost | $6,700 |

a. 6.5% was chosen as a typical Treasury bond interest rate.
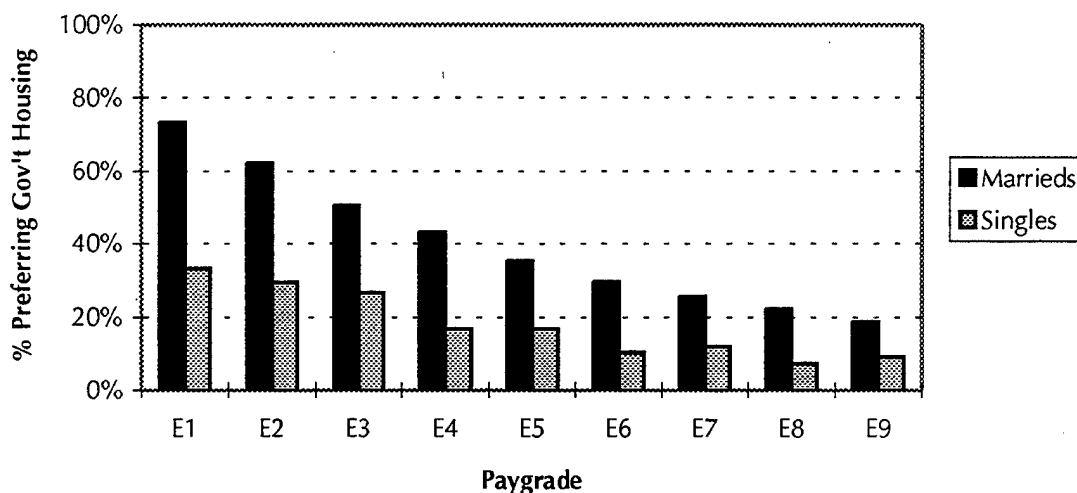
# Value to servicemembers

In the services, bachelors generally receive less in housing benefits than married members. Whereas married Sailors and Marines almost always have the option of accepting a housing allowance and living in the private sector, bachelors below E6 typically have been required to live on-base. Instead of the homes that marrieds live in, they are assigned a dorm room with one or more roommates. Worse yet, at any given time, 36,000 E1 to E5 bachelors are living on-board ship even though they are in homeport.[14]

Perhaps the best evidence about the lower value of bachelor housing comes from the 1995 VHA survey question about on-base housing preferences. There is a a remarkable difference in responses between marrieds and singles. Taking the survey question alone, and not adjusting for those living on-base,[15] single Sailors in the economy without dependents are about half as likely to prefer government housing as marrieds. Figure 11 shows these results.

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14. Beginning in 1997, E5 bachelors assigned to ships will have the option of receiving housing allowances.

15. Unlike married Sailors, most bachelors are required to live on-base. Therefore, we cannot assume that given the choice, they would still prefer base housing.

Figure 11. Housing preferences of those living off-base[a]

Additionally, direct surveys on servicemember satisfaction show bachelors to be somewhat less satisfied with their housing than married Sailors and Marines. These results, however, tend not to be as dramatic in scope as the VHA results. Reference [9] discusses these data further.

## Possible effects of unequal treatment

If bachelor servicemembers are not treated as well as their married counterparts, then we would expect to see certain effects. Servicemembers may have an added incentive to marry, and bachelors may not reenlist at the same rates as married servicemembers. A cursory look at the data suggests that both these results may be true.

Enlisted Sailors have a far higher marriage rate than the rest of the nation. Table 7 compares the marriage rates of Navy enlisteds aged 20 to 24 with those in the general population at the same age with only a high school diploma. The chance that a person aged 20 to 24 is married is almost 40 percent higher among Sailors than for the general

population. In addition, the marriage rates have been increasing over time. Figure 11 shows the trend by Navy enlisted paygrade since 1982. While E1 and E2 marriage rates have remained relatively stable, marriage rates among E3s to E5s have increased.

Table 7. Marriage rates among Navy enlisteds and the general population

|  | Nation[a] | Navy |
|---|---|---|
| Average (using Navy male/ female ratio) | 24% | 33%[b] |
| Males (age 20 to 24) | 22% | 32% |
| Females (age 20 to 24) | 42% | 34% |

a. National statistics are for individuals with only a high school diploma, listed in [10].
b. Percentage appears to be simple average due to rounding.

Figure 12. Navy marriage rates over time[a]
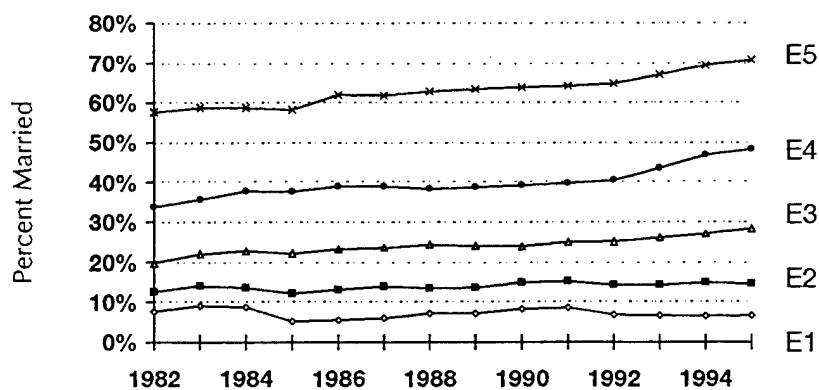


a. Source: EMR tapes.

Interestingly, according to table 7, females in the Navy are far less likely to be married than their civilian counterparts. This suggests that marriage decisions are much more complicated than this simple model, and that other factors must be considered before we have a complete picture.

Also, single Sailors reenlist at about half the rate as married Sailors. Figure 12 illustrates these rates. Although it makes intuitive sense to think that housing may be a factor in the reenlistment rates, evidence in [9] suggests there is actually little or no effect.

Figure 13. First-term reenlistment rates over time
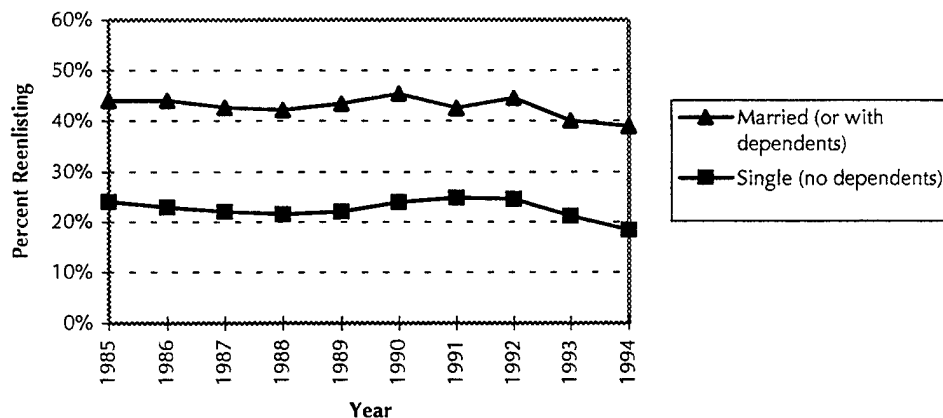


Finally, although there is strong evidence that bachelor housing is in fact much poorer than married housing, the reader should not conclude too much about its effect on marriage and reenlistment. Although the data show definite correlations, without fuller models of marriage and reenlistment, we cannot be sure about the amount, if any, that is actually contributed by poor bachelor housing. Such full

models of marriage and reenlistment are beyond the scope of this paper.

# Allowances

Servicemembers[16] who are not housed on-base are given tax-exempt housing allowances. Within the United States, housing allowances have two components: the Basic Allowance for Quarters (BAQ) and the Variable Housing Allowance (VHA). Together, they cover an average of 80 percent of their housing and utility costs. Servicemembers living off-base while stationed abroad receive an Overseas Housing Allowance (OHA), instead of VHA.

BAQ is paid to all servicemembers living off-base in the United States or abroad without regard to location. Married servicemembers or those with dependents are paid a fixed amount according to their paygrade; unlike base housing, the housing allowance is independent of family size.

Because housing prices vary significantly between locales, VHA was introduced in 1981 to help equalize benefits for those stationed in the United States. It is calculated from a survey taken each year of servicemember housing and utility expenditures. It is designed to equalize the median out-of-pocket expenses of servicemembers throughout the nation, regardless of locality.

BAQ and VHA were originally envisioned to cover 85 percent of the national median servicemember's housing and utility expenses for each paygrade. This "median" servicemember would absorb 15 percent of the expenses out-of-pocket. Rates would be set so that median servicemembers across different localities would absorb the same absolute amount out-of-pocket. The allowances were never fully funded, and in 1996 covered from 78 to 87 percent of median expenses[17] depending on paygrade. For most paygrades, the allowances cover about 80 percent of median expenses.

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16. Except for those bachelors who are housed full-time on-board ships.

Bachelors receive BAQ and VHA at a reduced rate. Typically, bachelor allowances are about 65 to 75 percent of the married rate for most paygrades.[18] Housing allowances for single servicemembers cover the same median percentage of housing costs as they do for married servicemembers.

BAQ is given to servicemembers without regard to the actual housing expenses. VHA, however, is tied to actual expenses. Servicemembers who do not spend their entire allowance must give back half of the unspent portion of VHA. This provision acts as a tax to encourage some servicemembers to spend more on housing than they otherwise would. Reference [11] further discusses the implications of the provision.

## Problems with VHA calculations

Because VHA is calculated from a survey of servicemember expenses, it has significant shortcomings.[19] The most important is that it shortchanges servicemembers in high-cost areas. In high-cost areas, people often trade off housing quality in order to buy other, relatively cheaper goods. Thus, the method used to calculate VHA then penalizes servicemembers in high-cost areas by cutting allowance rates. The result is that they cannot afford the same quality of housing as those in low-cost areas. On average, servicemembers in high-cost areas will not pay more out-of-pocket, but they will live in lower quality units.

Servicemembers in the lowest-cost areas, who receive only BAQ, generally get the best deal of all. They can get a higher quality unit and have lower out-of-pocket expenses, or perhaps none at all.

17. The 1996 allowances covered more than 85 percent of median expenses for E1 servicemembers only.

18. E1 bachelors get somewhat less; E8 and E9 bachelors get more.

19. This subsection is a summary of a fuller discussion found in work by Quester, et al. [12].

Compared to the other two services, these biases especially hurt the Navy and Marine Corps because so many of their bases are in high-cost areas.

Finally, the VHA methodology produces highly volatile rates. Often the calculations suffer from small sample sizes. Each year, VHA rates need to be set for 26 paygrades, 2 dependency statuses, and more than 300 areas. That requires more than 15,000 separate samples. Nearly 700,000 servicemembers live in the private sector, implying an average of 47 members for each estimated rate. Such small annual samples can produce highly volatile VHA rates. VHA rates can vary significantly between paygrades in unexpected ways. Some years, rates in one paygrade increase, while rates in others decrease. Occassionally, there are reversals where higher paygrades actually receive lower VHA rates. This is another indication that VHA does not accurately reflect local housing markets.

# Cost to government of allowances

Table 8 lists estimates of the average Navy allowance costs for married and single Sailors. The current allowance costs were calculated by adding the 1996 BAQ rate to the average Navy VHA rate[20] for each enlisted paygrade and then taking a weighted average over all enlisted Sailors receiving VHA. Added to the average family allowance cost is $200 of education impact aid funded by the Department of Education.

The first column of table 8 shows the average cost estimates for Navy enlisted personnel currently receiving allowances. If allowances were extended to all Navy enlisteds stationed in the United States, the average costs might change. The righthand column of table 8 estimates these broader averages. It is calculated by taking the weighted average of the allowance costs for all enlisted families and bachelors stationed in the United States. The average family allowance turns out to remain about the same, but the average bachelor allowance falls,

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20. These data were provided by BuPers.

because it is mostly senior bachelors at present who receive allowances.

Table 8. Annual allowance cost per enlisted Sailor stationed in the United States (FY 1996 $)[a]

| Type | Current off-base allowances | Allowance cost if extended to entire service |
|---|---|---|
| Families | $8,100[b] | $8,100[b] |
| Bachelors | $5,400 | $4,800 |

a. Source: BuPers, EMR tapes.
b. Includes $200 Department of Education school impact aid.

The average allowances in table 8 are actually overestimates because they neglect those Sailors in the United States who receive only BAQ.

# Conclusions

The separate administration of on-base family housing, on-base bachelor housing, and off-base allowances is highly inequitable, because it provides significantly different housing benefits to servicemembers within the same paygrade. For example, the 25 percent of Navy families on-base receive 40 percent of the budgeted Navy housing resources for families. This high subsidy for government family housing produces long waiting lists of 1 to 5 years.

Although the government spends an average of $15,100[21] annually per unit of family housing, evidence suggests that a majority of Sailors value this housing at between $8,600 and $11,000. Different demographic groups have different preferences for base housing. Larger families have greater preferences for base housing because they are assigned to larger homes when living on-base, but they receive no allowances other than the standard BAQ and VHA when living off-base. Surprisingly, servicemembers with long commutes have very low preferences for base housing. Servicemembers with military spouses also appear to prefer off-base housing; this is because the family receives a higher overall allowance and has a dual income. There is, however, a core of about one-third of Sailors who appear to value base housing very highly regardless of their allowance level.

Most evidence suggests that, within the United States, it is more efficient to house servicemembers in the private sector than in base housing. The government pays an average of $8,100[22] in housing allowances per year to married Sailors living off-base. Bachelors receive an average of $5,400 a year in housing allowances. However, most off-base bachelors are from the higher paygrades; if allowances

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21. This includes $2,000 of school impact aid from the Department of Education.

22. Includes $200 of school impact aid from the Department of Education.

were extended to all Navy bachelors, the average cost would drop to $4,800 per year. There are some calculation biases in the allowance rates, and the Sailors themselves currently have to cover about 20 percent of their total housing and utility costs out-of-pocket. The extra expense helps generate a demand among Navy families to live on-base.

The Navy justifies its requirement for base family housing by estimating a "deficit" of adequate private sector housing. The Navy calculates current housing "deficits" and projected future "deficits" for its bases. However, both calculations significantly overstate the need for base housing.

As a group, bachelors appear to be the worst off. Junior bachelors are required to live on-base in shared dormitory rooms. DoD is in the process of upgrading standards for bachelors; however, at present, the Navy and Marine Corps have very few of the new 1+1 bachelor quarters. Upgrading to the new standards will be expensive, costing about $53,500 per person or $107,000 per room. Construction and operation of these quarters will have an annualized steady-state cost of about $6,700 per person.

Under the present conditions, bachelors living off-base are half as likely to want base housing as their married counterparts. This indicates that Sailors value the on-base barracks far less than they value the family housing. In addition, at any given time, the Navy houses about 36,000 bachelor junior enlisted Sailors on-board ship even though they are in homeport. Although cost-effective for the Navy, these bachelors receive an inequitably low housing benefit.

Implications of these data are explored more fully in [1, 2].

# Appendix A: Logit regression results

## Logistic regressions

When the dependent variable is binomial (0,1), the survey respondent prefers or doesn't prefer Navy housing, the binomial logit is an appropriate estimator. Binomial logit regression analysis estimates the following relationship:

$$P(\text{prefer Navy housing}) \;=\; (1 + e^{-\beta' x})^{-1}\;,$$

where $P$ is the probability, $\beta'$ is a row vector of coefficients, and $x$ is a column vector of variables. Figure 14 shows an example of a logistic curve.

Figure 14. Example of a logistic curve
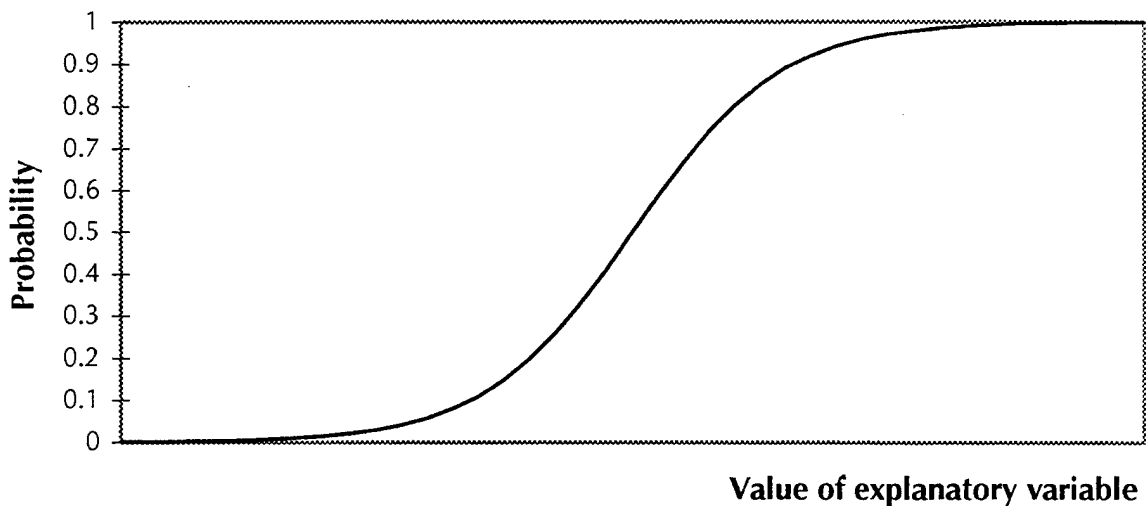
The partial derivative of the logit function—the effect of a change in a specific variable—depends on the location on the logit curve. At the mean of the sample it equals:

$$\frac{\partial P}{\partial x_i} = (P)(1-P)\beta_i ,$$

where $i$ is the $i$th variable and $P$ is the sample mean or proportion. The following equations illustrate this result:

$$P = \left(1 + e^{-\beta'x}\right)^{-1}$$

$$1 - P = \left(e^{-\beta'x}\right)\left(1 + e^{-\beta'x}\right)^{-1}$$

$$\frac{\partial P}{\partial x_i} = -\left(1 + e^{-\beta'x}\right)^{-2}\left(-\beta_i e^{-\beta'x}\right)$$

$$= \left(1 + e^{-\beta'x}\right)^{-1}\frac{(\beta_i)(e^{-\beta'x})}{(1 + e^{-\beta'x})}$$

$$= P(\beta_i)(1-P)$$

$$= (P)(1-P)\beta_i .$$

# Discussion of the logistic estimates

We include in this appendix the logistic regressions that we estimated. Tables 9 through 13 use data for the Navy and Marine Corps separately and together, and data at several specific locations. They detail:

- The variable definitions and the mean values for each variable

- The estimated logistic regression for housing preferences.

The major findings from these logistic regressions are discussed in the main text. The details behind those estimates are reviewed here.

Table 9 presents summary data for the Navy and Marine Corps. About 33 percent of those living off-base (and responding to the survey) would have preferred to live on-base if government housing had been available when they arrived at their duty station. The average family spends about $1,000 per month for housing and utilities. Of those families that live off-base, about half rent and half own their houses. Only about 5 percent of respondents said that their housing was either unsafe or unsuitable, but one-third said that it was unaffordable.

There are some differences between the services. Enlisted Marines are much more likely to be in the bottom four paygrades. Marines are slightly more likely to want to live on-base and pay less for housing, and they are more likely to rent than to own. All these characteristics are consistent with the lower paygrade distribution. Marines are also more likely to have a military spouse. About 8 percent of the Marines are dual military families compared to just over 5 percent for Navy families.

Table 10 lists results of logit regressions that predict preferences for on- and off-base housing. There is a consistent pattern for the Navy and combined enlisted personnel that the preference for on-base housing declines with paygrade. Relative to an E5, an E4 is 2 to 4 percent more likely to want to live in government housing. An E7 is predicted to be about 2 percent less likely to want to be on-base. In the Marine Corps regression results, there is no consistent pattern across paygrades even though that pattern does persist in the raw data presented in the text of this paper. Surprisingly, officers are substantially more likely to want on-base housing even when we control for housing cost and number of children. That may reflect that officers often have the opportunity to live in larger detached housing on-base. In the combined sample, the model predicts that, holding other factors constant, Marines are about 3 percent more likely to prefer government housing.

There is strong evidence that the number of children in the family influences preferences. Couples with no children are about 8 percent less likely to prefer on-base housing than couples with one child. Preference for on-base housing continues to increase, by about 3 percent,

for each additional child. This relationship reflects the fact that the number of bedrooms provided in government housing increases with family size while allowances in the private sector do not.

Families made up of two active duty military are much less likely to want to live on-base. The estimate of this effect ranges from 12 percent for the Navy to 20 percent for the Marines. This difference reflects two facts. Dual military families receive allowances about 60 percent higher than families with only one servicemember. That increases the implicit rent of on-base housing. The difference also reflects the fact that dual income families are more likely to prefer to live in the private sector. The data in this survey aren't sufficient to separate those two effects.

Families who rent their homes in the private sector are much more likely to prefer on-base housing. The size of the coefficient on this variable indicates that homeowners are very unlikely to prefer on-base housing. The coefficient on monthly housing costs is negative indicating that the more a family spends on housing the less likely they are to prefer government housing. In theory, if rental prices increase, we expect families to be more likely to prefer government housing, but this is not always the case. An explanation for this surprising result is that families who choose to spend more on private sector housing have more resources available to them.

Several measures in the survey are designed to identify inadequate housing. A series of questions asks families if their housing is unsafe, unsuitable, or unaffordable. Another question asks about the length of commute. Families who believe that their housing is unsafe are 5 percent more likely to want to live in military housing. Those who describe their housing as either unsuitable or unaffordable are 13 percent more likely to want to live in military housing. Surprisingly, the length of commute doesn't increase the preference for government housing. In fact, families that commute more than half an hour are about 10 percent less likely to prefer on-base housing. Families who commute more than 1 hour are even less likely to want to live on-base. These families are normally counted as creating a deficit that requires new construction of government housing.

Table 9. Variable definitions and mean values

| Variable | Variable definition | Variable mean (Navy and Marine Corps) | Variable mean (Navy) | Variable mean (Marine Corps) |
|---|---|---|---|---|
| E-1/2 | 1 if E1 or E2 | .011 | .011 | .012 |
| E-3 | 1 if E3 | .052 | .037 | .117 |
| E-4 | 1 if E4 | .120 | .116 | .136 |
| E-5[a] | 1 if E5 | .216 | .223 | .185 |
| E-6 | 1 if E6 | .232 | .250 | .148 |
| E-7 | 1 if E7 | .115 | .115 | .114 |
| E-8 | 1 if E8 | .046 | .045 | .052 |
| E-9 | 1 if E9 | .021 | .020 | .024 |
| Warrant Officers | 1 if Warrant Officer | .013 | .010 | .027 |
| O-1 to O-3 | 1 if O-1 to O-3 | .122 | .117 | .145 |
| O-4 to O-6 | 1 if O-4 to O-6 | .053 | .056 | .038 |
| Marine | 1 if in USMC | .172 | - | - |
| Children | Number of children | 1.4 | 1.4 | 1.3 |
| Military spouse | 1 if spouse is in the military | .056 | .052 | .077 |
| No child | 1 if the number of children equals 0 | .303 | .294 | .345 |
| Renter | 1 if family rents | .54 | .52 | .62 |
| Cost | Monthly cost of housing ($) | 998 | 1,012 | 930 |
| Unsafe | 1 if respondent defines current housing as in an unsafe neighborhood | .047 | .046 | .052 |
| Unsuitable | 1 if respondent defines current housing as unsuitable | .057 | .057 | .058 |
| Unaffordable | 1 if respondent defines current housing as unaffordable | .338 | .337 | .344 |
| Mod commute | 1 if the commute to work is 16 - 30 minutes | .475 | .471 | .497 |
| Long commute | 1 if the commute to work is 31 - 60 minutes | .282 | .292 | .233 |
| Bad commute | 1 if the commute to work is more than 60 minutes | .049 | .047 | .056 |
| On-base | 1 if prefer Navy housing | .330 | .321 | .371 |
| *Sample size* | | 89,224 | 73,839 | 15,385 |

a. In the logistic regressions that follow, one category is omitted and all estimates are relative to it. For grade, the omitted category is E-5.

Table 10. Binomial logit regression estimates for housing preference[a]

| Variable | Both services Parameter estimate (std. error) | Both services Derivative of conditional mean function[b] | Navy Parameter estimate (std.error) | Navy Derivative of conditional mean function | Marine Corps Parameter estimate (std.error) | Marine Corps Derivative of conditional mean function |
|---|---|---|---|---|---|---|
| Intercept | -1.357* (.04) | | -1.446* (.04) | | -.891* (.095) | |
| E-1/2 | .898* (.07) | .199 | 1.025* (.08) | .228 | .346* (.159) | .077 |
| E-3 | .248* (.036) | .055 | .438* (.04) | .097 | -.107 (.066) | -.024 |
| E-4 | .099* (.026) | .022 | .192* (.03) | .043 | -.307* (.063) | -.068 |
| E-6 | -.044* (.023) | -.010 | -.051* (.03) | -.011 | .006 (.063) | .001 |
| E-7 | -.076* (.030) | -.017 | -.099* (.03) | -.022 | .001 (.063) | .000 |
| E-8 | -.153* (.043) | -.034 | -.178* (.05) | -.040 | -.098 (.096) | -.022 |
| E-9 | -.166* (.06) | -.037 | -.248* (.07) | -.055 | .079 (.134) | .017 |
| Warrant Officers | .071 (.7) | .016 | .042 (.10) | .009 | .209* (.120) | .046 |
| O-1 to O-3 | .366* (.03) | .138 | .300* (.03) | .067 | .558* (.068) | .123 |
| O-4 to O-6 | .407* (.04) | .090 | .325* (.05) | .072 | .815* (.113) | .180 |
| Children | .159* (.009) | .035 | .163* (.006) | .036 | .132* (.023) | .029 |
| Military spouse | -.636* (.038) | -.141 | -.554* (.04) | -.123 | -.918* (.081) | -.203 |
| No child | -.206* (.025) | -.046 | -.204* (.008) | -.045 | -.199* (.057) | -.044 |
| Renter | 1.056* (.019) | .234 | 1.075* (.02) | .239 | .965* (.046) | .213 |
| Cost (00s) | -.026* (.003) | -.006 | -.02* (.003) | -.004 | -.044* (.007) | -.010 |
| Marine | .125* (.020) | .028 | | | | |
| Unsafe | .199* (.036) | .044 | .214* (.04) | .048 | .161* (.081) | .036 |

Table 10.  Binomial logit regression estimates for housing preference[a] (continued)

| Variable | Both services | | Navy | | Marine Corps | |
|---|---|---|---|---|---|---|
| | Parameter estimate (std. error) | Derivative of conditional mean function[b] | Parameter estimate (std.error) | Derivative of conditional mean function | Parameter estimate (std.error) | Derivative of conditional mean function |
| Unsuitable | .571* (.033) | .126 | .558* (.04) | .124 | .628* (.079) | .139 |
| Unaffordable | .578* (.017) | .128 | .579* (.02) | .129 | .586* (.039) | .130 |
| Mod commute | -.181* (.020) | -.040 | -.166* (.02) | -.037 | -.216* (.045) | -.048 |
| Long commute | -.387* (.023) | -.086 | -.359* (.02) | -.080 | -.459* (.054) | -.102 |
| Bad commute | -.577* (.042) | -.128 | -.596* (.05) | -.132 | -.505* (.091) | -.112 |

a. An asterisk means statistically significant at 1-percent level (two-tailed test). The chi-square statistic for -2 times the log likelihood ratio indicates both logistic regressions are statistically significant at the .0001 level.

b. The derivative of the conditional mean function is the (average probability)(1 - average probability) times the parameter estimate. Here, it is (33)(.67) = .222 times the parameter estimate.

Table 11. Variable means at five locations

| Variable | Variable mean (San Diego) | Variable mean (Norfolk) | Variable mean (Hawaii) | Variable mean (Camp Pendleton) | Variable mean (Camp Lejeune) |
|---|---|---|---|---|---|
| E-1/2 | .014 | .012 | .007 | .023 | .020 |
| E-3 | .048 | .044 | .034 | .228 | .161 |
| E-4 | .137 | .139 | .145 | .224 | .176 |
| E-5[a] | .225 | .233 | .231 | .161 | .166 |
| E-6 | .237 | .249 | .244 | .118 | .146 |
| E-7 | .119 | .116 | .093 | .083 | .098 |
| E-8 | .044 | .048 | .041 | .031 | .050 |
| E-9 | .023 | .019 | .022 | .019 | .021 |
| Warrant Officers | .011 | .012 | .007 | .018 | .032 |
| O-1 to O-3 | .100 | .090 | .135 | .076 | .113 |
| O-4 to O-6 | .039 | .037 | .041 | .018 | .017 |
| Children | 1.3 | 1.5 | 0.9 | 1.0 | 1.3 |
| Military spouse | .059 | .058 | .087 | .080 | .090 |
| No child | .327 | .271 | .510 | .448 | .347 |
| Renter | .60 | .47 | .74 | .77 | .58 |
| Cost | 1,124 | 934 | 1,377 | 925 | 719 |
| Unsafe | .070 | .044 | .035 | .100 | .038 |
| Unsuitable | .078 | .045 | .066 | .075 | .043 |
| Unaffordable | .433 | .259 | .482 | .434 | .264 |
| Mod commute | .525 | .450 | .485 | .502 | .636 |
| Long commute | .262 | .403 | .210 | .323 | .204 |
| Bad commute | .055 | .025 | .007 | .067 | .021 |
| On-base | .382 | .255 | .357 | .266 | .383 |
| *Sample size* | 13,641 | 20,627 | 1,133 | 3,105 | 3,184 |

a. In the logistic regressions that follow, one category is omitted and all estimates are relative to it. For grade, the omitted category is E-5.

Table 12. Binomial logit regression estimates for housing preference at three Navy locations[a]

| Variable | San Diego Parameter estimate (std. error) | San Diego Derivative of conditional mean function[b] | Norfolk Parameter estimate (std.error) | Norfolk Derivative of conditional mean function | Honolulu, HI Parameter estimate (std.error) | Honolulu, HI Derivative of conditional mean function |
|---|---|---|---|---|---|---|
| Intercept | -1.463* (.12) | | -1.885* (.102) | | -1.203* (.460) | |
| E-1/2 | .856* (.16) | .202 | 1.194* (.138) | .305 | 1.051 (.768) | .241 |
| E-3 | .277* (.090) | .065 | .768* (.079) | .196 | .375 (.354) | .086 |
| E-4 | .067 (.063) | .021 | .289* (.054) | .074 | .335 (.209) | .077 |
| E-6 | -.030 (.057) | -.007 | -.014 (.052) | -.004 | .084 (.191) | .019 |
| E-7 | .003* (.073) | .001 | -.046 (.069) | -.012 | -.531* (.290) | -.122 |
| E-8 | -.007 (.106) | -.002 | -.287* (.106) | -.073 | .187 (.375) | .043 |
| E-9 | -.144 (.151) | -.034 | -.284* (.167) | -.072 | .075 (.531) | .017 |
| Warrant Officers | .133 (.191) | .031 | .037 (.19) | .009 | -.987* (1.107) | -.227 |
| O-1 to O-3 | .502* (.078) | .119 | .522* (.076) | .133 | -.029* (.247) | -.007 |
| O-4 to O-6 | .361* (.119) | .085 | .510* (.116) | .130 | .439 (.399) | .101 |
| Children | .175* (.024) | .041 | .244* (.020) | .062 | .154 (.108) | .035 |
| Military spouse | -.532* (.086) | -.126 | -.453* (.083) | -.116 | -.683* (.264) | -.157 |
| No child | -.213* (.061) | -.050 | -.103* (.056) | -.026 | -.149 (.221) | -.034 |
| Renter | 1.159* (.057) | .274 | 1.141* (.045) | .291 | 1.101* (.218) | .253 |
| Cost (00s) | -.018* (.007) | -.004 | -.041* (.008) | -.010 | -.025 (.024) | -.006 |
| Unsafe | .137* (.076) | .032 | .351* (.079) | .090 | -.180 (.358) | -.041 |
| Unsuitable | .539* (.075) | .127 | .491* (.079) | .125 | .780* (.267) | .026 |

Table 12. Binomial logit regression estimates for housing preference at three Navy locations[a]

| | San Diego | | Norfolk | | Honolulu, HI | |
|---|---|---|---|---|---|---|
| Variable | Parameter estimate (std. error) | Derivative of conditional mean function[b] | Parameter estimate (std.error) | Derivative of conditional mean function | Parameter estimate (std.error) | Derivative of conditional mean function |
| Unaffordable | .536* (.040) | .149 | .555* (.039) | .142 | .114 (.139) | .026 |
| Mod commute | -.069 (.053) | -.016 | -.090* (.053) | -.023 | -.120 (.151) | -.028 |
| Long commute | -.084 (.060) | -.020 | -.202* (.056) | -.052 | -.155 (.191) | -.036 |
| Bad commute | -.632* (.105) | -.149 | -.371* (.132) | -.095 | -.354 (.889) | -.081 |

a. An asterisk means statistically significant at 1-percent level (two-tailed test). The chi-square statistic for -2 times the log likelihood ratio indicates both logistic regressions are statistically significant at the .0001 level.

b. The derivative of the conditional mean function is the (average probability)(1 - average probability) times the parameter estimate. Here, it ranges from .19 to .24 across the different samples.

Table 13. Binomial logit regression estimates for housing preference at two Marine Corps locations[a]

| | Camp Pendleton | | Camp Lejeune | |
|---|---|---|---|---|
| Variable | Parameter estimate (std. error) | Derivative of the conditional mean function[b] | Parameter estimate (std.error) | Derivative of the conditional mean function |
| Intercept | -1.264* (.328) | | -2.055* (.229) | |
| E-1/2 | .143 (.275) | .028 | 1.575* (.299) | .136 |
| E-3 | -.319* (.135) | -.062 | .810* (.144) | .191 |
| E-4 | -.325 (.135) | -.063 | .300* (.142) | .071 |
| E-6 | -.323 (.135) | -.063 | .498* (.153) | .118 |
| E-7 | -.421* (.205) | -.082 | .265 (.178) | .063 |
| E-8 | -.160 (.289) | -.031 | .322 (.228) | .076 |
| E-9 | .196 (.347) | .038 | .824* (.312) | .195 |

Table 13. Binomial logit regression estimates for housing preference at two Marine Corps locations[a] (continued)

| Variable | Camp Pendleton | | Camp Lejeune | |
| --- | --- | --- | --- | --- |
| | Parameter estimate (std. error) | Derivative of the conditional mean function[b] | Parameter estimate (std.error) | Derivative of the conditional mean function |
| Warrant Officers | .306 (.337) | .060 | 1.338* (.241) | .316 |
| O-1 to O-3 | .472* (.190) | .092 | 1.888* (.164) | .446 |
| O-4 to O-6 | -.263 (.428) | -.051 | 1.811* (.320) | .428 |
| Children | .122* (.062) | .024 | .261* (.053) | .062 |
| Military spouse | -.601* (.181) | -.117 | -.871* (.165) | -.206 |
| No child | -.188 (.133) | -.037 | .022 (.128) | .005 |
| Renter | .719* (.166) | .140 | 1.216* (.106) | .051 |
| Cost(00s) | -.034* (.020) | -.007 | -.026 (.016) | -.006 |
| Unsafe | .213 (.140) | .042 | .234 (.205) | .055 |
| Unsuitable | .386* (.156) | .075 | .348 (.197) | .082 |
| Unaffordable | .446* (.089) | .087 | .607* (.093) | .143 |
| Mod commute | -.067 (.136) | -.013 | -.074 (.117) | -.017 |
| Long commute | -.150 (.145) | -.029 | -.315* (.139) | -.074 |
| Bad commute | -.545* (.228) | -.106 | -.657* (.322) | -.155 |

a. An asterisk means statistically significant at 1-percent level (two-tailed test). The chi-square statistic for -2 times the log likelihood ratio indicates both logistic regressions are statistically significant at the .0001 level.

b. The derivative of the conditional mean function is the (average probability)(1 - average probability) times the parameter estimate. Here, it ranges from .19 to .24 across the different samples.

We created some subsamples to examine differences in housing choices across different markets. We collected data from three Navy sites—San Diego, Norfolk, and Honolulu—and two Marine Corps sites—Camp Pendleton and Camp Lejeune. Table 11 displays data means for the five sites. There are some differences in demographics. For example, families in Hawaii are generally smaller than in the other locations. There are also substantial differences in both the cost of private sector housing and in the preferences for on-base housing.

Table 12 presents results of regressions for the three navy subsamples. Because of the small sample sizes, the results from Hawaii are not generally reliable. The results from the other two sites are consistent with the Navy-wide regression results. The size of the predicted effects of independent variables appear to be larger in Norfolk than in San Diego although the patterns are very similar.

Table 13 displays the regression results from the two Marine Corps sites. As in the overall sample, there is no consistent pattern of preferences across enlisted paygrades. The other coefficients follow the general pattern seen in the larger samples.

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